

ORGANIZATIONAL KNOWLEDGE CREATION

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Abstract. *The purpose of this paper is to present an overview of the state-of-the-art in organizational knowledge creation, a field of research that is expanding almost exponentially. Knowledge creation is a dynamic capability that enables firms to achieve a sustainable competitive advantage on the market. Our purpose is to critically analyze the most significant ideas published in this field, and especially to present the most important models elaborated for organizational knowledge creation: Nonaka's model, Nissen's model, Boisot's model, and the EO_SECI model. Also, we would like to identify the main determinants of the knowledge creation process.*

Keywords: *Ba, competitive advantage, knowledge, knowledge creation, SECI.*

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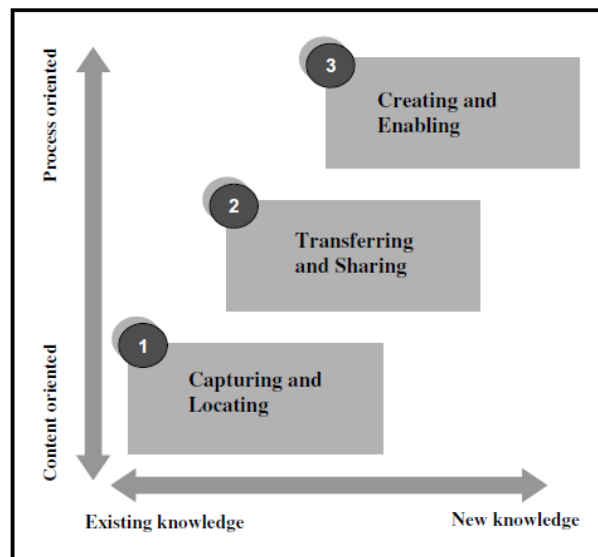
1. Introduction

The advocates of the knowledge Based-view of the organization (Spender, 1996; Nonaka, Takeuchi, 1995; Nonaka, Ichijo, 2007) emphasize that the two predominant goals of the organization are the *generation* and the *application* of knowledge. An organization that has the ability to create knowledge on an ongoing basis has the advantage of having developed a unique capability of being dynamic (Mitchell, Boyle, 2010). The competence to generate and apply new organizational knowledge is considered as one of the main sources of the competitive advantage of the firm (Leonard-Barton, 1990; Nonaka, 1994; Spender, 1996; Zollo, Winter, 2002). If knowledge is a source of competitive advantage, then, then understanding and managing knowledge dynamics become vital for the firm (Heinrichs, Lim, 2005). In the same time, there is a high risk that knowledge dynamics might generate anti-competitive effects on the market (Dima, 2008; Dima, 2010). The organization that wishes to cope dynamically with the changing environment must be able to create knowledge better and faster than its competitors (Gore, Gore, 1999). Creativity is associated with that part of the innovation process which is labeled as 'idea generation' (McAdam, 2003).

Heap (1989, cited in McAdam, 2003), defined creativity as: "*the synthesis of new ideas and concepts, where innovation is the implementation of creativity*". Titus (2000, cited in McAdam, 2003) regards creativity as "*the birth of imaginative new ideas*". Therefore, the process of knowledge creation is described as a composition of descriptors, as part of the creativity process: "*the ability to originate novel and useful idea*" (Marakas, 1999), "*chaotic, unstructured and unsystematic*" (Davenport, Prusak, 2000), "*when a firm acquires and adopts knowledge from others, it modifies knowledge to make it suitable*" (Bhatt, 2000).

As a consequence of the importance of knowledge creation within business management literature has dedicated considerable efforts to studying this process. The study of literature revealed that there are three distinct phases of knowledge management: before the 90s, the early 90s and the late 90s (Figure 1). In the first phase of knowledge management managers focused on data and information processing, and on information systems management. The goal was to observe, gather, store in data bases, and manage existing knowledge in information systems as any other assets. In the second phase, knowledge management focused on the organizational knowledge sharing process. In the third phase the focus changed to the sources and stimulating factors of knowledge creation. Nonaka's contribution to the knowledge creation theory development integrates the knowledge creation process (SECI) with the place (the concept of *Ba* as a space for knowledge creation), and with the enabling conditions (leadership, organizational culture, learning). This theory emphasizes the importance of knowledge context and stimulating conditions within an organization. Knowledge is generated in a given social context. As a consequence, knowledge is contextual. It is created in a specific context, and it has a meaning relevant to that specific context (Jakubik, 2008). Thus, the new theories and models of

knowledge creation expand this process from individuals toward groups and organizations. Organizational knowledge creation in this new vision is quite different from the individual knowledge creation, since it includes both the epistemological and ontological dimensions of this process. Knowledge creation does not have anymore an absolute result but only a relative one, measured with respect to the organizational context.



Source: Hoegl, Schulze (2005).

Figure 1. Evolution of knowledge management initiatives

2. The knowledge-based theory of the firm

Firms that want to change their business domain and to switch to a more profitable industry have to face rather high entry barriers. In a strategic analysis, the resource-view theory explains the differences between firms in terms of the difficulties that firms have in acquiring resources. Firms that want to acquire the resources that gave other firms a competitive advantage are prevented from doing so because those resources are almost impossible to get, or too costly to be obtained. In short, the resource-based theories explain the differences among firms as a result of profit-maximizing firms' inability to imitate successful firms. However, in a long run thinking profits are not any more the sole purpose of the firm. In explaining the difference between the success of one firm and the failure of another we have to also take into consideration subjective elements such as knowledge. In neoclassical economic theory, the employees of an organization are generally viewed as undifferentiated from their knowledge, while the organization is viewed as an

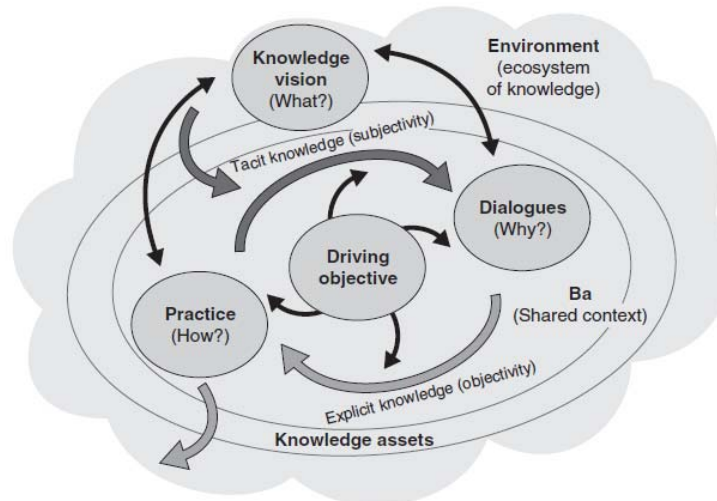
information-processing machine to overcome the bounded rationality of people, as decision makers. Knowledge-based theories of the firm view humans not as replaceable parts of a machine but as beings who differ from each other due to their different vision about life and work. In this view humans are purposeful beings who will act to realize their visions and ideals (Nonaka, Toyama, Konno, 2000; Nonaka, Toyama, 2007). In the organizational knowledge-creating process, individuals interact with each other going beyond their own boundaries and, as a result, change themselves, others, the organization, and the environment.

In Western epistemology, knowledge has been defined as “*justified true belief*” (Nonaka, Takeuchi, 1995). This formulation gives the impression that knowledge is something objective, absolute, and context-free. However, this may not be necessary true since it is humans who hold and justify beliefs. Knowledge cannot exist without human subjectivity. “Truth” differs if we are to take into consideration the values of the person that holds that truth and the context in which we look at it. On the other hand the Eastern epistemology regards knowledge as “*a meaningful set of information that constitutes a justified true belief and/or an embodied technical skill.*” Thus, the knowledge creation is defined as “*a dynamic human process of justifying a personal belief toward the truth and/or embodying a technical skill through practice*” (Nonaka, Takeuchi, 1995; Nonaka, Umemoto, Senno, 1996). The Japanese thinkers tend to consider knowledge as primarily “tacit,” personal, context-specific, and not so easy to communicate to others. Westerners, on the other hand, tend to view knowledge as “explicit,” formal, objective, and not so difficult to process with computers. But these two types of knowledge are not totally separate, they are mutually complementary entities. They interact one with each other and even may transform one into the other, in given specific conditions.

The knowledge-creating theory developed especially by the Japanese thinkers is based on the assumption that knowledge inherently includes human values and ideals. The knowledge creation process cannot be described only as a normative causal model because human values and ideals are subjective and the concept of truth depends on values, ideals, and contexts. Unlike traditional views of knowledge, the knowledge-creating theory does not treat knowledge as something absolute and infallible. In such a case, it is hard to create new knowledge or achieve the universality of knowledge (Nonaka, Toyama, 2007).

3. Knowledge creation determinants

Developing the knowledge-based theory of the firm Nonaka and his co-workers have described the basic components of a generic knowledge-creating firm. In a knowledge-creating firm the knowledge is created through dynamic interactions with the environment. The model proposed by the Japanese authors consist of seven components: the SECI model, knowledge vision, driving objectives, *Ba* - an existential place for the SECI process, knowledge assets, and the environment (Nonaka, Toyama, 2007).



Source: Nonaka, Toyama (2007).

Figure 2. Basic components of a knowledge-creating firm

The *knowledge vision* of a firm is an integral part of the strategic vision of organization, and it is strongly related to the fundamental question “why do we exist?” The knowledge vision results from the strategic management of the firm and it gives a direction to the process of knowledge creation. If the strategy of a firm can change as the situation evolves, and uncertainty about the future decreases, the knowledge vision does not change so easily, because of its own nature.

The knowledge vision is extremely important in the knowledge creation process as it inspires the intellectual passion of the organization’s members so that they are encouraged to create knowledge. It also defines a consistent value system to evaluate and justify the knowledge created in the organization (Bratianu, Jianu, Vasilache, 2007). The organization needs a value system in order to define what truth, goodness, and beauty are for the organization (Nonaka, Toyama, 2007).

The knowledge vision must be accompanied by the actual effort to realize it, otherwise it remains just a beautiful formulation. For knowledge to be created and justified on the basis of the firm’s knowledge vision, the firm needs a concrete concept, goal, or action standard to connect the vision with the knowledge-creating process of dialogue and practice. Such a concept standard is often called a *driving objective* because it drives the knowledge-creating process (Nonaka, Toyama, 2007).

Knowledge creation is guided through the synthesis of contradictions, which is actually an old philosophical principle (Nonaka, Toyama, 2007). The world is full of contradictions, and duality becomes an essence of reality. By accepting such duality and synthesizing it, one must go beyond the binary thinking yes/no, or 0/1, like

in data processing. Synthesis can be realized by using dialectical thinking and action. In the soft Eastern philosophy, everything is placed into a given context, and understood in relation to the whole, instead of being considered as an absolute truth (Nisbett, 2003).

Synthesis in organizational knowledge creation may be obtained through social interaction. One can pursue the essence of seemingly contradictory things and accept others' views through dialogues. Dialogue is also a very efficient way of learning others' views that are different from one's own, and to accept and synthesize them. The dialogues create meanings. For instance, at Toyota, managers encourage dialogues to take place in daily operation at every level through the practice of "ask *why* five times." When you are asked again and again for the basis of the reason you came up with, it becomes inevitable to ask the essential reason behind your thought or action.

Leadership in the knowledge-creating firm is based on the concept of distributed leadership, rather than on leadership conceived as rigid and fixed control mechanism. Since knowledge is created through dynamic interaction, leadership in a knowledge-creating firm requires active commitment from all members of the organization, not just a few elite members (Nonaka, Toyama, 2007).

Apart from the components described above, Bhatt (2000) considers that *learning* is necessary for the development and creation of new knowledge. However, learning does not guarantee that knowledge learnt is useful and adaptive to the environments. In fact, exploitation of past knowledge can be useful only to the point when environments remain stable. If environments start changing, learning of existing rules and technologies can be an overhead to human minds and the organization. Because knowledge creation is a dynamic process, unlearning existing programs and learning new sets of capabilities often becomes essential. Cohen and Levinthal (1990, cited in Bhatt, 2000) have provided an important link between learning capability and knowledge creation. They argue that knowledge expansion is dependent upon learning intensity, and prior learning of the concepts, which they refer to as an organization's absorptive capacity.

Organization learning has become a necessity for the survival of businesses. A learning culture in organizations is important as it opens up informal and formal channels to dialectical thinking, debates, and critiques. However, if an organizational culture does not promote experimental learning, informal peer reviews, and informal guidance, it is likely to be stuck with the knowledge that it is no longer effective in a fast changing environmental context.

Organizational culture defines how a person is identified within the organization, and how that person conceives its system of values and how he/she relates it to his/her own system (Sarabia, Corro, Sarabia, 2006). Culture is important in knowledge creation, because, "*a good part of our knowledge has been learned as culture from older generations*" (Nonaka, Takeuchi, 1995). Also, tacit knowledge consists mostly of culture (Hong, Kianto, Kylaheiko, 2008). Culture is a highly

nonlinear field of forces, a very strong integrator that is able to influence organizational behaviour and knowledge management activities at different levels.

The mediating function of culture does not mean that culture or cultural models impose on organizational routines, knowledge behaviours and capabilities, but that organizational culture is both embedded in and built through routines and static and dynamic capabilities. On the other hand, the shared culture plays a central role in mediating functioning. Thus, the significance of organizational culture should be understood in terms of dynamic processes rather than static structures. Cultural and communicative interaction is the key to understanding the complex and recursive relationships between culture, knowledge, routines, and capabilities in dynamic environments (Hong, Kianto, Kylaheiko, 2008).

4. Nonaka's knowledge dynamics model

4.1. Basic characteristics

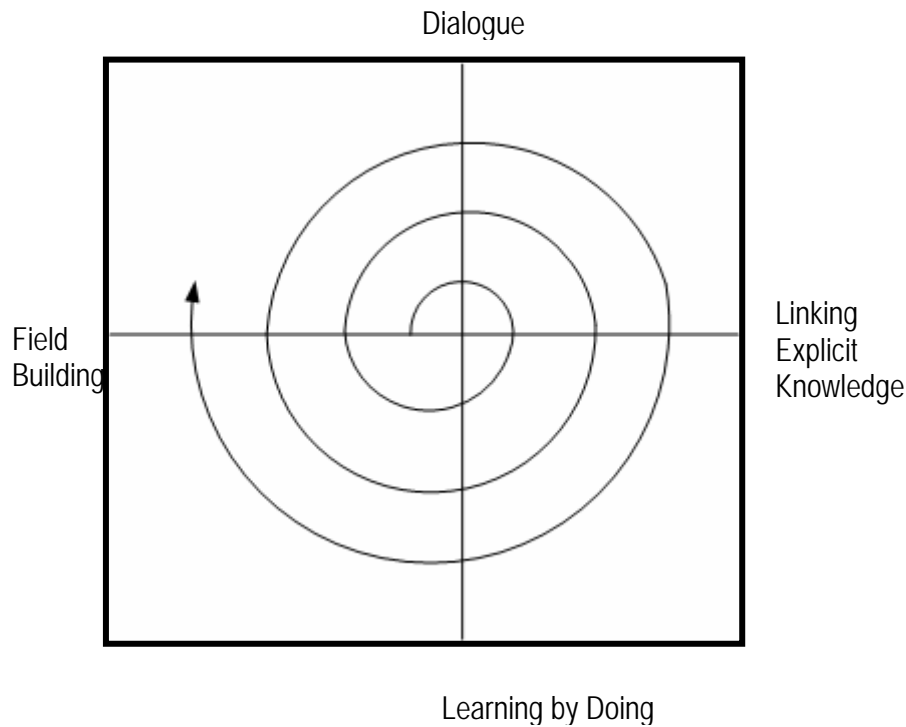
The best known knowledge dynamics model has been originated in Nonaka's research (Nonaka, 1991; Nonaka, 1994), and then it has been continuously developed in a classical Japanese way through incremental contributions coming from his co-workers (Nonaka, Byosiene, Borucki, Komo, 1994; Nonaka, Takeuchi, 1995; Nonaka, Komo, 1998; Nonaka, Toyama, Byosiene, 2001; Nonaka, Toyama, 2007). Basically, this model contains three main structures: the SECI model, the *Ba* shared context, and the knowledge assets platform. From philosophical point of view, this model has an epistemological dimension and an ontological dimension. The *epistemological dimension* describes the transformation of the tacit knowledge into explicit knowledge, and the reverse action, the transformation of the explicit knowledge into tacit knowledge. The *ontological dimension* describes the transformation of individual knowledge into group knowledge, and then, the transformation of the group knowledge into organizational knowledge, with possible reverse actions from the organization toward group and individual. Further, the whole organization may exchange knowledge with its operational environment, conceived as a knowledge ecosystem.

The framework of this model has been taken from the resource-based theory of the firm, where the tangible resources have been replaced with intangible resources, and all material processes have been replaced with intangible operations. Actually, any firm contains both tangible and intangible resources, and knowledge dynamics represents the complementary component of the tangible dynamics of the organization. Thus, knowledge management appears as an integral part of the operational and strategic management of the firm. The driving force of the knowledge dynamics model is the knowledge vision which gives a direction to knowledge creation. "*It also gives the firm direction with respect to the knowledge to be created beyond the firms' existing capabilities, and therefore determines how the firm evolves in the long run*" (Nonaka, Toyama, 2007, p. 18). The knowledge vision is intrinsically

related to the value system of the firm, which defines what is truth, goodness and beauty for the whole organization. For instance, at Honda, the focus is on the joy of buying, selling and creating products and services beyond the mere competition and financial metrics. Based on this knowledge vision the firm defines some driving objectives that are the engine of the whole knowledge dynamics model.

4.2. The SECI knowledge cycle

The epistemological dimension is exploited in the four stage process known as SECI: Socialization – Externalization – Combination – Internalization. Each stage represents a cornerstone of the operational knowledge dynamics (Figure 3). *Socialization* is considered by Nonaka and his co-workers the most important knowledge transfer of this cycle since it involves the hidden and sticky part of all knowledge created at individual level. It is the tacit knowledge (Polanyi, 1983). Tacit knowledge is generated by direct experience of each individual and it goes to the non-rational mind. As Nonaka and Takeuchi (1995, p. 8) emphasize, “*Tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others. Subjective insights, intuitions, and hunches fall into this category of knowledge. Furthermore, tacit knowledge is deeply rooted in an individual’s action and experience, as well as in the ideals, values, or emotions he or she embraces*”. Tacit knowledge contains basically two components: a technical component which reflects the know-how of professional activities, and a cognitive component which reflects mental models, beliefs and perceptions as a result of many performed similar actions. Tacit knowledge embraces also highly subjective insights, intuitions and hunches. Leaders usually make use of these fine ingredients of tacit knowledge, being able to inspire and motivate their followers. Socialization is an opportunity for participating individuals to share their experiences and to learn through a direct exchange of tacit knowledge. It is well known the way apprentices learn from their masters through continuous observation and imitations. Socialization is conceived not only for workers from the same team or department but also for meetings of firm employees with their customers and suppliers. However, socialization must go beyond the everyday dialogues and exchange of neutral phrases. It must stimulate deeper layers of experiences and stored knowledge. Actually, only individuals with higher levels of understanding and knowledge richness can transfer tacit knowledge to the others. At the organizational level this idea is used by promoting the *best practice*. The identification and the transfer of best practices is one of the most recent methods used in operational management for accelerating the adaptation process of the firm. However, this method is not fully efficient due to the difficulty of exchanging tacit knowledge characterized by the internal stickiness (Szulansky, 1996; Szulansky, Jensen, 2004). Also, there is a series of individual and organizational factors that slow down or inhibit this knowledge transfer during socialization (Bratianu, 2008; Bratianu, 2009a; Bratianu, Orzea, 2010).



Source: Nonaka, Takeuchi (1995).

Figure 3. SECI model and the knowledge spiral

Externalization is an individual process through which the tacit knowledge is transformed into explicit knowledge. Once the knowledge becomes explicit it can be shared, disseminated and transferred to others through verbal and nonverbal languages. “*Of the four modes of knowledge conversion, externalization is the key to knowledge creation because it creates new, explicit concepts from tacit knowledge*” (Nonaka, Toyama, Byosiore, 2001, p. 495). However, externalization is a highly motivational process and the success of knowledge conversion depends on the capacity of using efficiently metaphors, analogies and cognitive models. Metaphors play an important role in developing new concepts and theories by making use of known ones (Andriessen, 2006; Andriessen, 2008; Lakoff, Johnson, 1999). For instance, using the metaphor of energy, Bratianu and Andriessen suggested that externalization can be compared with energy transformation from its potential form into the kinetic form (Bratianu, Andriessen, 2008). However, while in the energy domain this transformation is based on the conservation law, in the knowledge domain there is no such a law. Knowledge is not a finite matter and its conversion cannot be

put into a strict mathematical formulation, like in the case of conservation energy formulation. Yet, this metaphor is very useful in understanding that through externalization knowledge potential becomes available for codification, dissemination, storage and propagation. Analogy helps us understand the unknown in terms of known concepts, and bridge the gap between an image and a logical model. The efficiency of the externalization process can be increased by education and a solid motivation. Motivation is important in fuelling the necessary efforts to be done. Individuals frequently ask themselves why to make the effort of transforming tacit knowledge into explicit knowledge, loosing this way a good deal of ownership over their knowledge. Finally, we should emphasize the fact that while tacit knowledge is very fuzzy and very hard to evaluate, explicit knowledge is well defined and can be evaluated. Thus, externalization is a process of reducing the entropy of our total knowledge, by structuring and integrated new created knowledge into the existing explicit knowledge structures. Externalization is an antientropic process.

Combination is a process of creating new network structures of explicit knowledge by integrating pieces of explicit knowledge into new integral structures. According to Nonaka, Toyama, Byosiére (2001, p. 496), “*In practice, combination entails three processes. First, explicit knowledge is collected from inside or outside the organization and then combined. Second, the new explicit knowledge is disseminated among the organizational members. Third, the explicit knowledge is edited or processed in the organization in order to make it more usable*”. Unlike externalization that is a purely individual process, combination is basically a social process based on the communicable property of explicit knowledge. Combination takes place in a specific organizational context, and thus it is intrinsically related to the concept of *Ba*. However, we would like to emphasize the fact that knowledge transfer can be done only from a higher level of knowing toward a lower level of knowing, in accordance to the entropy law. For instance, if an individual would like to disseminate a news which is already known by the audience, there is no knowledge transfer. Actually, this is a drawback of the SECI model, since there is no correlation between the flow of knowledge and the entropy law (Bratianu, 2010). This lack of correlation may lead easily to the *knowledge perpetuum mobile* situation, very similar to the *energy perpetuum mobile*, which is a practical impossibility.

Internalization is an individual process. According to Nonaka, Toyama, Byosiére (2001, p. 497), “*Internalization is the process of embodying explicit knowledge as tacit knowledge. It is closely related to learning-by-doing. Through internalization, knowledge that is created is shared throughout an organization. Internalized knowledge is used to broaden, extend, and reframe organizational members’ tacit knowledge*”. Knowledge is internalized through an integration process in the already known knowledge. If necessary, this integration will re-structure the old knowledge. This new internalized knowledge increased the level of individual understanding and his absorptive capacity. Also, it increased the chances of individual participation in a socialization process, and in sharing the tacit knowledge contributing this way to the upward development of the knowledge spiral. Internalization is closing

the circle of knowledge creation, a process which is developing through continuous social interaction. Socialization and combination are processes of knowledge transfer in a social context, while externalization and internalization are processes of knowledge conversion at the individual level. Organizational knowledge creation is a continuous process moving upward on the knowledge spiral, where the horizontal field of forces is generated by the epistemological nature of the individual learning process, and the vertical field of forces is generated by the ontological nature of the organization. Knowledge creation originates within the individual employee and is developing through social interaction from individuals to teams, and then from teams to the whole organization.

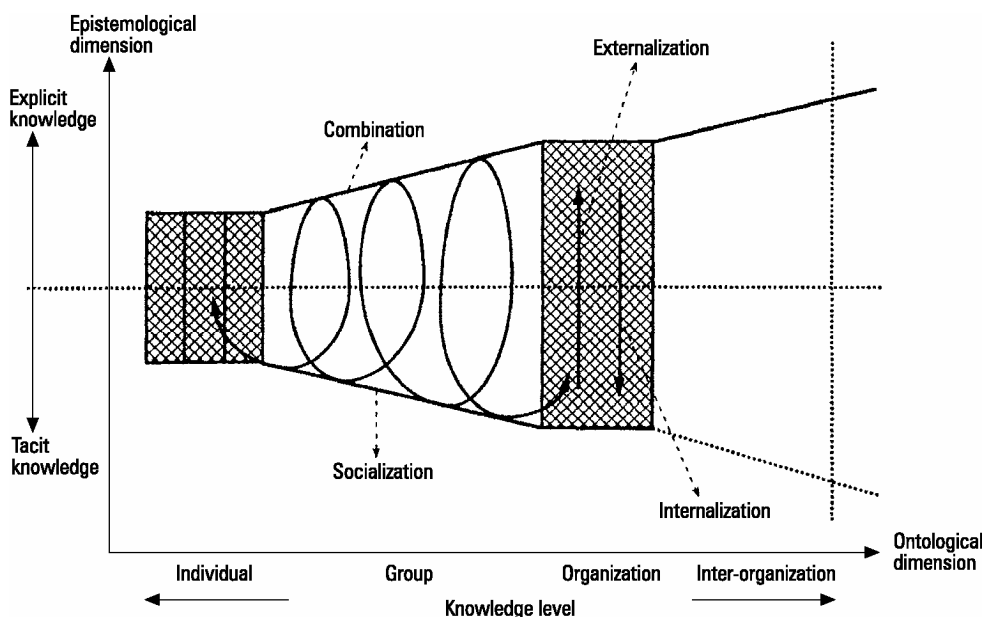
The SECI model has been used by Nonaka and Takeuchi (1995) to explain how Japanese companies create the dynamics of innovation, building up an important competitive advantage. However, there are some shortcomings of this model. The first and the most important one comes from the fact that Eastern perspective on knowledge is different than the Western perspective on knowledge (Andriessen, Boom, 2007; Gourley, 2006; Harsh, 2009; Nonaka, Takeuchi, 1995). While in the Western perspective the emphasis is put on explicit knowledge, in the Eastern perspective, the emphasis is put on tacit knowledge. In the same time, the Japanese way of thinking is rather fuzzy in order to create an interaction liberty, and to stimulate the social contribution to the knowledge upgrading. In the Western managerial thinking, communications should be very precise in order to eliminate this liberty of different interpretations coming from social interaction. Being very strict on meanings, the Western management reduces systematically the knowledge spiral described by the SECI model. Another drawback is the fact that imposing the entropy law to the flow of knowledge, i.e. the flow is always directed from the higher level of knowing toward the lower level of knowing, the knowledge spiral cannot be sustained. The SECI cycle leads to a *knowledge perpetuum mobile*, a mechanism of knowledge generation functioning for ever without consuming any resources. In the energy field such a mechanism is impossible. Finally, the SECI model is making use of the old dyad: tacit knowledge – explicit knowledge. In economics and management a new dyad is used more frequently: cognitive knowledge – emotional knowledge (Bratianu, 2009b; Hill, 2008).

4.3. Ba: The foundation for knowledge creation

The kernel of the Nonaka's knowledge dynamics model is the concept of *Ba*. The word roughly means "place" in Japanese, but it is hard to be translated in other language.

According to Nonaka and Toyama (2007, p. 23), "*The essence of Ba is the contexts and the meanings that are shared and created through interactions which occur at a specific time and in a specific space, rather than a space itself. Ba also means relationships of those who are at the specific time and the specific space*". Externalization and internalization on one hand, and socialization and combination on

the other hand need a specific context of meanings and a framework of same thinking patterns in order to be operational. This context is considered to be *Ba*. Thus, *Ba* is in the same time a physical and a non-physical space where social interchange can take place and generate knowledge. It can be a context for an individual, a team or even an organization. *Ba* is a shared context in motion, since it is constantly under change forces. It is a conceptual working space where individual subjectivity meets the others objectivity and through social interaction knowledge is generated. Using *Ba*, Nonaka and his co-workers developed also the two dimensional diagram for knowledge transformation from individuals to groups and organization, according to the epistemological and ontological dimension (Figure 4).



Source: Nonaka, Takeuchi (1995).

Figure 4. Organizational knowledge creation

Actually, in the knowledge-based theory of the firm, the whole organization is interpreted “as an organic configuration of multilayered *Ba*”. It means that we have to look into not only the formal organizational structure of the firm, but also the meanings that are created at *Ba*, and the relationship among them. Also, this concept is related to the Japanese specific interpretation of no-thing-ness: “No-thing-ness is not to be understood as a ‘thing’ because it then would be based on a conception of something, which would be no-thing... If you understand what exists then you can understand that which does not exists. This means that although it is impossible to know that which does not exists, it is possible to know that if “anything is anything, then everything is everything’... The spirit of no-thing-ness means that there is no

such thing as relying upon anything at all outside of your individual mind” (Kaufman, 1994, pp. 104-105).

The SECI map of dynamic interactions can be superposed on a *Ba* field, and the following components may be identified: originated *Ba* – the context where socialization face-to-face take place; dialoguing *Ba* – the context where externalization takes place and peer-to-peer knowledge sharing develops; systemizing *Ba* – the context where combination takes place through social collaboration, and explicit knowledge can be disseminated; exercising *Ba* – the context where internalization can be realized (Nonaka, Toyama, Byosiene, 2001).

4.4. Knowledge assets

Knowledge assets are intangible resources that contribute to value creation. They can be inputs or outputs of the SECI process. According to Nonaka, Toyama, 2007, p. 25), *“Knowledge assets are not just the knowledge already created, such as know-how, patents, technologies, or brands, but also include the knowledge to create, such as the organizational capability to innovate. Although current views on knowledge assets tend to focus on the former because they are easier to measure and deal with, it is the latter that need more attention because they are the source of new knowledge to be created, and therefore a source of the future value of the firm”*. In the Japanese firms, one of the most important knowledge-asset is *kata* which reflects a specific way of doing things. It is not a routine or a standardized procedure, but it is a thinking pattern that is able to create a self-renewal process. The main three steps of *kata* are the following: *shu* (learn), *ha* (break), and *ri* (create). That means that such a thinking pattern is dynamic, and it can be changed when becomes obsolete. Creation is a continuous process, including these thinking patterns of the firms. A firm with a good *kata* is looking toward future, and the past successes are only sources of knowledge.

Finally, the knowledge-based theory of the firm contains the *ecosystem of knowledge* which reflects the external business environment. This ecosystem is conceived as a multilayered structure of *Ba* across the firm boundaries. According to Nonaka and Toyama (2007), through continuous interactions with ecosystem, a firm generates knowledge. This knowledge influences both the internal and external business environments. In this perspective, both the organization and the ecosystem develop together increasing the chances for realizing the competitive advantage. Such a complex and integrated view is rather difficult to be grasped by using the resource-based theory of the firm.

5. Nissen’s knowledge dynamics model

While the Nonaka’s knowledge dynamics is based on knowledge conversions through social interactions, the Nissen’s knowledge dynamics is based on the idea of flows. The firm is a place where knowledge flows continuously along some directions.

"As explained in this book, the concept knowledge flows represents more than just a metaphor: it explains the phenomenon of how knowledge moves through an organization. In the context of organizational performance, knowledge flows lie on the critical paths of the work flows they enable" (Nissen, 2006, p. XX). Knowledge flows should be understood both in time and in space. In time, individuals create or acquire knowledge which contributes to their development. Also, considering the ontological dimension, knowledge flows from individuals to groups of people and then to the whole organization. In space, knowledge flows across offices, departments and different organizational structures. Since organizations are open systems, knowledge flows across boundaries toward the external business environment. However, the flow of tacit knowledge is slowly and with many Barriers due to its sticky nature (Szulansky, 1996). Also, by comparison with motion in physics, we can talk about *knowledge inertia*, and organizational forces able to overcome this inertia. Actually, knowledge flows only due to a pressure difference between the emitter and the receiver. This pressure difference should be interpreted as a difference in the level of knowing and understanding. However, Nissen does not explain how knowledge flow actually happens and how the gradient of knowing is created.

Nissen took as the basis of his model the Nonaka's two dimensional model defined by the *epistemological* and *ontological* dimensions. Then, he added two new dimensions: life cycle and flow time. *Life cycle* refers to the different sequences of activities associated with the knowledge flows, like: knowledge creation, knowledge sharing and knowledge use. *Flow time* refers to the time duration expressed in minutes, days or years required for knowledge to move from one person, organization, place, or time to another (Nissen, 2006). These four dimensions characterize the complete knowledge dynamics model elaborated by Nissen. The life cycle activities are associated with the SECI knowledge conversions: socialization, externalization, combination and internalization. Thus, Nissen associates tacit knowledge sharing to socialization, and the flow is directed from individual toward the group. The next sequence is externalization, which is associated with the flow of knowledge from tacit to explicit. Actually, this is a knowledge conversion. Once the knowledge becomes explicit, the flow can be visualized at the group level. Combination is associated with the flow of explicit knowledge from group toward the whole organization. Here there are several activities which can be identified: knowledge storing, retrieval, codifying, disseminating, re-structuring and re-contextualizing. This is a sequence of the life cycle where IT can be heavily involved. Finally, internalization is associated to the knowledge flow from explicit toward tacit. Knowledge flows can be associated to individual and organizational learning cycles. Since the explicit knowledge flow is faster than the tacit knowledge flow, Nissen associates the notion of "light mass" with explicit knowledge, and "heavy mass" with tacit knowledge. Thus, the flow time for the explicit knowledge is usually short, while for the tacit knowledge is long. On the whole, the Nissen knowledge dynamics model gives a better view of the organizational knowledge structure and flows, as well as a working tool to identify the resistances different flows may have within the organization. It is an expanded and

more detailed Nonaka's model by incorporating the time dimension. Although Nonaka considers his work to be a knowledge dynamics model, the meaning of the concept "dynamics" comes from knowledge conversions and not from time. Nissen's dynamics model incorporates the time dimension and thus, his model is fully a dynamic model.

6. Boisot's knowledge dynamics model

Boisot developed a more abstract model of knowledge dynamics based on the theory of information. He conceived the I-Space as a generic domain characterized by three dimensions: codification, abstraction, and diffusion. *Codification* refers to the way we make use of explicit knowledge. Tacit knowledge is fuzzy and hard to formalize. Explicit knowledge can be expressed clearly, explained and codified. In a general formulation, codification is a process by which we create conceptual categories that facilitate the classification of events and phenomena (Boisot, 1999). Codification is an individual activity which depends on the intellectual skill and experience of the subject. Usually, discrete events can be codified more easily than events which vary continuously. From a very practical point of view, codification helps especially when we would like to create data and knowledge bases, and to use efficiently IT. Codification is also important in the process of developing expert systems and programs of knowledge retention. *"Codification constitutes a selection from competing perceptual and conceptual alternatives. The more of these are to choose from, the more time such a selection will require and the more problematic it will become"* (Boisot, 1999, p. 44).

The second dimension of the I-Space is abstraction. *Abstraction* acts on the structure of concepts and phenomena by reducing the concrete details and local positioning. From a very practical point of view, abstraction reduces the number of categories from which we choose codified events. *"When properly carried out, abstraction allows one to focus on the structures, causal or descriptive, that underline the data. It generates concepts rather than percepts"* (Boisot, 1999, p. 50). Abstraction and codification are interlinked processes converging towards economizing on data processing resources. Codification helps abstraction by defining categories and making them easy to handle, while abstraction reduces the number of categories whose boundaries need to be defined.

The third dimension of the I-Space is diffusion. This is a concept taken from science where it defines the property of spreading out a given substance under the influence of a gradient of forces. In his model, Boisot considers *diffusibility* as a property of data and knowledge to spread out into a target population. However, unlike the physical world where diffusion is a natural process, in a social environment knowledge diffusion depends also on the human behaviour. It is not enough to have a gradient of knowing and a given population, like employees within an organization, to experience a knowledge diffusion. It is also necessary for people to consider that knowledge and to use it in order to complete the diffusion. Thus, diffusion becomes a

conscious phenomenon. According to Boisot (1999, p. 55), *“To summarize: lower level technical consideration will affect the diffusibility and hence the availability of information within a given population. Higher level social and cultural considerations will influence the absorption of information within that population and hence the rate at which it is taken up and used”*.

The I-Space is a conceptual framework that show how information and knowledge flow within a group of people or an organization, with respect to the three dimensions considered above: codification, abstraction and diffusion. For instance, a flow of knowledge toward more abstraction and codification will show a greater availability toward given population, all other things being equal. This I-Space model helps us understand more easily the creation and diffusion of new knowledge in an organization, and also how it works the social learning cycle (SLC). This cycle is composed of six major phases:

- Scanning – Identifying possible treats and opportunities in the external business environment, as signals and trends. Scanning can be performing rapidly when knowledge is well codified and abstract, and very slowly when it is fuzzy.
- Problem solving – Finding solutions to the problems identified and well defined.
- Abstraction – Generalizing the application of new codified knowledge to a larger spectrum of applications.
- Diffusion – Sharing the newly created knowledge within the group or organization.
- Absorption – Integrating the new knowledge into the learning cycle.
- Impacting – The embedding of abstract knowledge in concrete practices.

These sequences need not be strictly linear. They can run such that some of them are developing in the same time, concurrently. I-Space is very useful in showing not only the direction of knowledge flow but also the possible frictions and obstacles within a given population. However, Boisot’s knowledge dynamics model remains more abstract than the other models and it can be used as a complementary tool for understanding the dynamics of knowledge within an organization.

7. The EO-SECI knowledge dynamics model

This model has been developed by a research group formed of: Gregorio Martin de Castro, Pedro Lopez Saez, Jose Emilio Navas Lopez and Raquel Galindo Dorado (2007). Basically it is an extension of the Nonaka’s SECI model, by considering the both dimensions, i.e. epistemological and ontological, being interlinked dynamically at the four distinct levels: individual, group, organizational and interorganizational. Actually, the name of this model comes from: E – epistemological dimension; O – ontological dimension; S – socialization; E – externalization; C – combination;

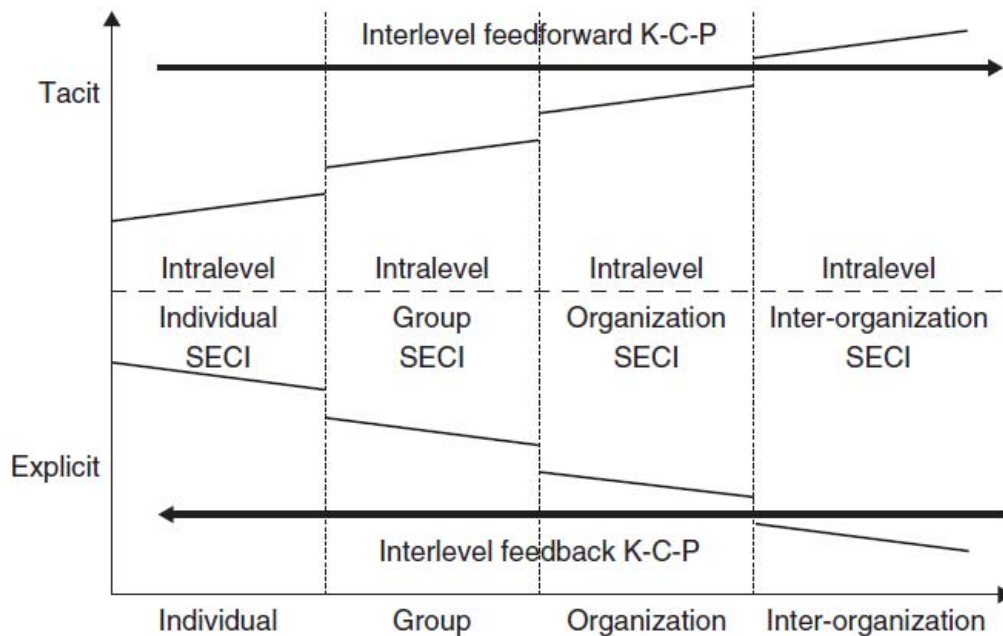
I – internalization. According to its authors, the essential characteristics of this extended and expanded model are the following:

- Considering that within each ontological phase there are the four conversions defined by Nonaka: socialization, externalization, combination and internalization.
- The treatment of knowledge upward dynamics as a result of all four processes mentioned above.
- Knowledge develops along the ontological dimension from one phase to another, without any other intermediate transformations.
- Considering two simultaneous adjacent streams of knowledge with respect to the main upward stream, reflecting the feedforward and the feedback of the whole process. These two adjacent streams lead to a self-reinforcing loop, which represents a better description than the knowledge spiral described by Nonaka and Takeuchi (1995).

This model can be represented graphically by a two dimensional diagram (Figure 5). The two coordinate axes are the epistemological dimension (vertical), and the ontological dimension (horizontal). The epistemological dimension yields the transformation from tacit to explicit knowledge, while the ontological dimension yields the transformation from individual to group, organization and inter-organizations levels. Thus, there are four main ontological domains: individual, group, organization and inter-organization. The main idea of this new perspective is to consider that in each of these four ontological domains there is a SECI cycle, which is coupled then with the neighboring domains.

According to the authors of this model (Castro et al., 2007, p. 61), *“Knowledge-creation entities are granted learning capabilities as they are conceded an own SECI cycle to develop internally. This SECI, taken directly from the work of Nonaka and Takeuchi (1995), explains knowledge creation within each of these entities, through 16 processes. We argue that an internal cycle of knowledge conversion takes place at each ontological level, so each level becomes an entity with learning and knowledge-creating capabilities”*.

This knowledge dynamics model has been tested by a thorough research of the knowledge intensive firms considered from Boston’s Route 128 (MA, USA), and Spain. Knowledge intensive industries are those that employ as main production factors what we may term high technology and human capital. The research results demonstrated that the EO-SECI model can explain much better the knowledge dynamics within a firm, since it expands the four main knowledge conversions to each ontological level (individual, group, organization, inter-organization).



Source: Castro et al. (2007).

Figure 5. EO-SECI diagram representation

8. Conclusions

Knowledge creation becomes a kernel issue of the knowledge management, since it is intrinsically related to the competitive advantage. Thus, knowledge as an intangible resource proved to be a strategic one, and knowledge creation a core competence of the firm. Knowledge is not anymore conceived as an objective and scientific entity, but as a integration of subjectivity and objectivity able to reflect a part of the reality. Knowledge dynamics models try to explain the organizational knowledge creation, in a larger perspective of both tacit and explicit knowledge. The purpose of this paper is to critically discuss the state-of-the-art in this exploding field of knowledge creation, and to present the main characteristics of the most developed and significant models designed to reflect organizational knowledge dynamics. The impressive work done by Nonaka and his co-workers is complemented by the contributions brought by Nissen, Boisot and the Spanish team coordinated by Gregorio Martin de Castro.

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